

1           CLAIMS

2       1.    A seal assembly for sealing an annular space  
3           between an inner and an outer pipe in a double-  
4           walled subsea pipeline which seal assembly:

5           (a)   under normal operating conditions is in a  
6                non-sealing position which allows the  
7                passage of a gas through said seal  
8                assembly; and

9           (b)   is actuatable from a non-sealing position  
10           to a sealing position in response to the  
11           entry of liquid into said annular space.

12  
13       2.    A seal assembly according to claim 1 which

14           (a)   in its non-sealing position provides an  
15                opening in the annular space to allow the  
16                passage of a gas through the seal  
17                assembly; and

18           (b)   comprises an annular member and moveable  
19                blocking means such that entry of liquid  
20                into said annular space causes movement of  
21                said blocking means to close said opening.

22  
23       3.    A seal assembly according to claim 2 wherein  
24           the blocking means is moveable under pressure  
25           of liquid flow.

26  
27       4.    A seal assembly according to claim 2 which  
28           comprises a liquid-sensitive material and  
29           wherein the blocking means is moveable as a  
30           result of interaction of the liquid with said  
31           liquid-sensitive material.

32

1     5. A seal assembly according to claim 3 wherein  
2         (a) the annular member comprises one or more  
3             orifices; and  
4         (b) the moveable blocking means comprises a  
5             diaphragm and a closure member such that  
6             flow of liquid in said annular space  
7             causes movement of the diaphragm which  
8             causes movement of the closure member to  
9             close said one or more orifices.

10  
11     6 A seal assembly according to claim 5 wherein  
12         the diaphragm and closure member are both  
13         annular in shape.

14  
15     7 A seal assembly according to any one of claims  
16         2 to 4 wherein:  
17         (a) the annular member comprises one or more  
18             valves; and  
19         (b) said valves each comprising one or more  
20             orifices and moveable blocking means such  
21             that flow of liquid in said annular space  
22             causes movement of the moveable blocking  
23             means to close said one or more orifices.

24  
25     8 A seal assembly according to claim 7 wherein a  
26         valve comprises a blocking plate with an  
27         orifice and the moveable blocking means  
28         comprises a diaphragm and a closure member  
29         which closure member has apertures such that  
30         flow of liquid in the annular space causes  
31         movement of the diaphragm which causes movement  
32         of the closure member against the blocking

1 plate closing the orifice in the blocking plate  
2 and the apertures in the closure member.  
3

4 9 A seal assembly according to claim 7 wherein  
5 the moveable blocking means comprises biased  
6 means attached to a closure member which biased  
7 means is held in a biased position by means of  
8 a liquid-sensitive material such that flow of  
9 liquid in said annular space causes interaction  
10 of said liquid with said liquid-sensitive  
11 material causing said liquid-sensitive material  
12 to release the biased means so that said biased  
13 means effects movement of the closure member to  
14 close said one or more orifices.  
15

16 10 A seal assembly according to claim 9 wherein  
17 the biased means is a spring.  
18

19 11 A seal assembly according to claim 9 or 10  
20 wherein the liquid-sensitive material is a  
21 water-soluble salt.  
22

23 12 A seal assembly according to any one of claims  
24 7 to 12 wherein the annular member comprises  
25 one or more tubes in which tubes the one or  
26 more valves are situated.  
27

28 13 A seal assembly according to any one of the  
29 preceding claims wherein the annular member is  
30 dimensioned so that it will extend from the  
31 inner wall of the outer pipe to the outer wall  
32 of the inner pipe and will be in sealing

1 contact with each of said inner and said outer  
2 walls.

3

4 14 A seal assembly according to any one of claims  
5 1 to 3 wherein

6 (a) the annular member is dimensioned so that  
7 it will be sealing contact with only one  
8 of the inner wall of the outer pipe and  
9 the outer wall of the inner pipe and will  
10 provide an opening in said annular space  
11 between the annular member and the wall  
12 with which it is not in sealing contact;  
13 and

14 (b) the moveable blocking means comprises  
15 resilient means which is deformable under  
16 the pressure of liquid flow in the annular  
17 space to close said opening.

18

19 15 A seal assembly according to claim 14 wherein  
20 the annular member has a longitudinal end face  
21 which has a recess to define upper and lower  
22 arms and one of these arms is the resilient  
23 means deformable under the pressure of liquid  
24 flow in the annular space to close said  
25 opening.

26

27 16 A seal assembly according to claim 13 or claim  
28 14 which comprises annular restraining means  
29 bonded to the upper and lower arms of the  
30 annular member.

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- 1     17    A pipe system comprising an inner and an outer  
2            pipe and a seal assembly according to any one  
3            of the preceding claims.  
4  
5     18    A valve suitable for use in the seal assembly  
6            of any one of claims 7 to 12.  
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